

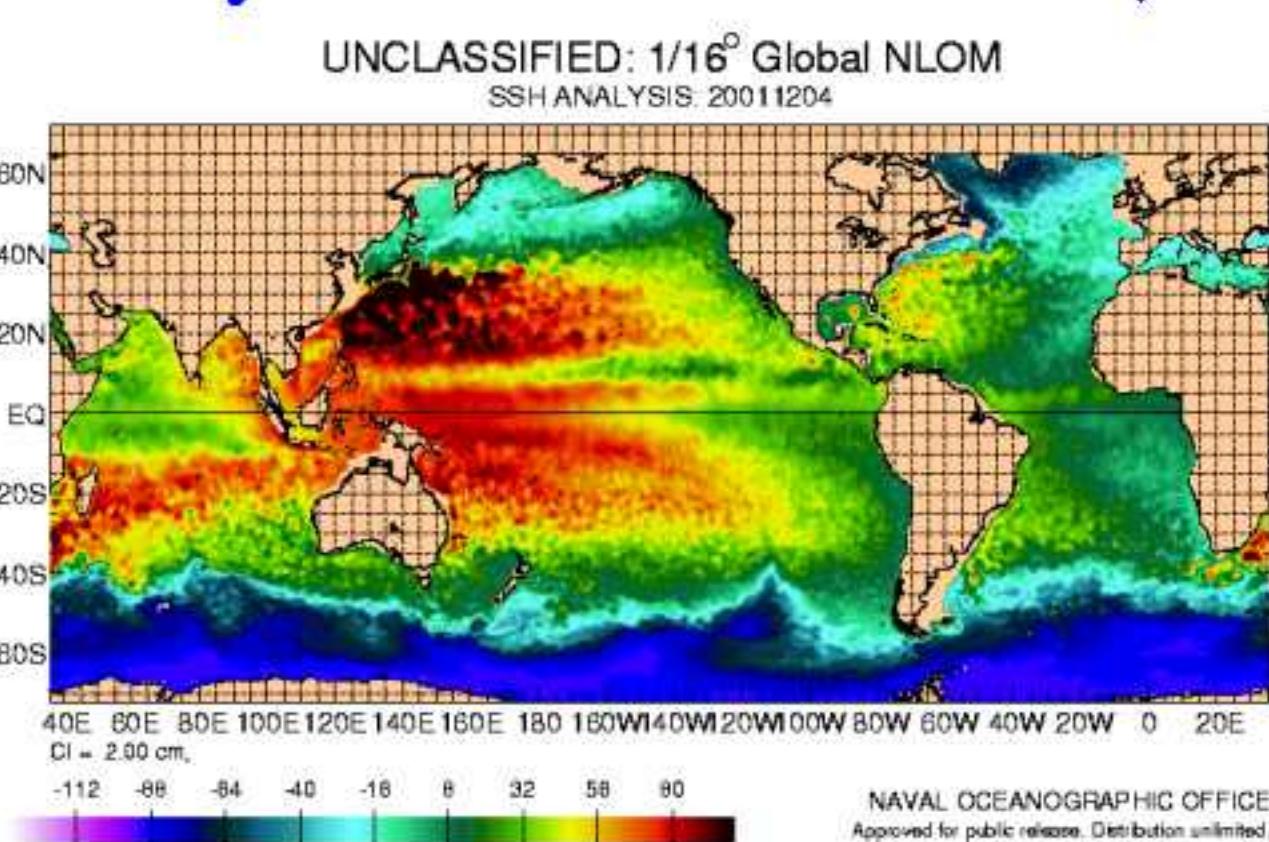
An Operational Eddy Resolving (1/16°) Global Ocean Nowcast/Forecast System

Real-Time and archived results (updated daily): http://www7320.nrlssc.navy.mil/global_nlom

Abstract

A real-time eddy-resolving global ocean nowcast/forecast system has been running at the Naval Oceanographic Office (NAVOCEANO) since 18 October 2000. The system, which was developed at the Naval Research Laboratory (NRL), uses a NRL Layered Ocean Model (NLOM) with 1/16° resolution and 7 layers in the vertical. Real-time satellite altimeter sea surface height (SSH) from TOPEX/POSEIDON, ERS-2 and Geosat-Follow-On provided by NAVOCEANO's Altimeter Data Fusion Center (ADFC), are assimilated into the model. The large size of the model grid (4096x2304x7) and operational requirements makes it necessary to use a computationally efficient ocean model and assimilation scheme. The assimilation consists of an optimum interpolation (OI) deviation analysis of SSH with the model as a first guess, a statistical inference technique for vertical mass field updates, geostrophic balance for the velocity updates outside of the equatorial region and an incremental updating of the model fields to further reduce gravity wave generation. A spatially varying mesoscale covariance function determined from TOPEX/POSEIDON and ERS-2 data is used in the OI analysis. The sea surface temperature (SST) assimilation consists of relaxing the NLOM SST to the Modular Ocean Data Assimilation System (MODAS) SST analysis which is performed daily at NAVOCEANO. Real-time and archived results from the model can be viewed at the NRL web site http://www7320.nrlssc.navy.mil/global_nlom. This includes many zoom regions, nowcasts and forecasts of SSH, upper ocean currents and SST, forecast verification statistics, subsurface temperature cross-sections, the amount of altimeter data used for each nowcast from each satellite and nowcast comparisons with unassimilated data. The results show that the model has predictive skill of the mesoscale variability for at least one month.

NRL Layered Ocean Model (NLOM)



- NRL global primitive equation ocean circulation model**
- 7 layers including the mixed layer**
- Forced by real-time NOGAPS surface heat fluxes and wind stresses**
- Assimilates satellite altimetry data and MODAS SST analysis**
- Provides SSH and Front & Eddy forecast capability**

Data Assimilation Methodology

- OI deviation analysis using the model as first guess**
 - Mesoscale data covariance from T/P + ERS-2 data calculated by Jacobs et al.
 - 3-day window for altimetry
- Subsurface statistical inference via EOF regression**
 - Including the abyssal layer which has a major impact on the upper ocean circulation, Hurlburt et al. (1990, JGR-O)
- Velocity changes via geostrophy**
 - Outside of equatorial band
- Incremental updating to minimize gravity wave generation**
- Assimilation cycles need to go back approximately 3 days to pick up altimeter data with improved orbit removal**
 - More recent altimeter data with less accurate orbits are also used
- Relaxation to the daily MODAS SST analysis**

Forcing used in operational NLOM

Winds: 1.0° FNMOC NOGAPS surface stresses

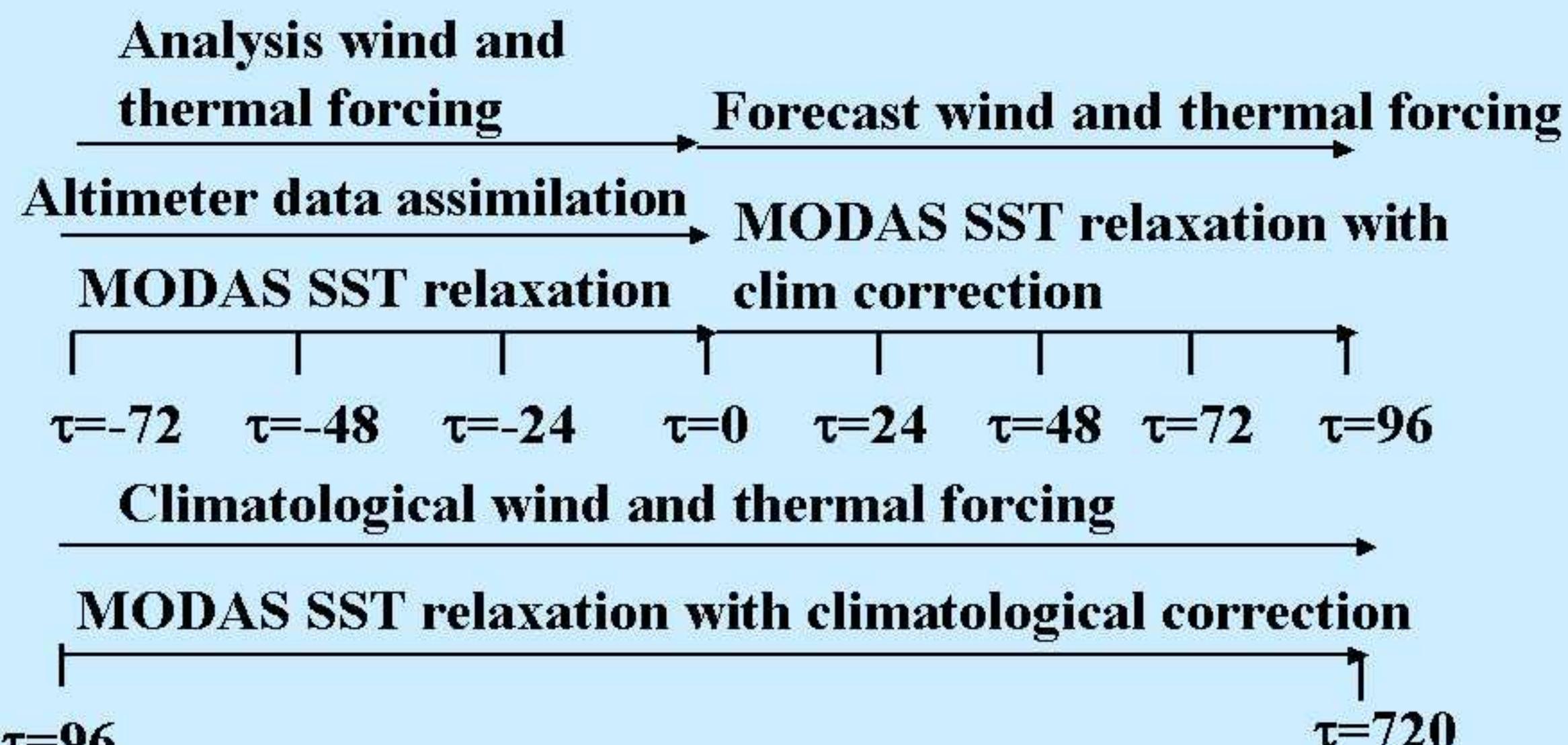
Thermal: 1.0° FNMOC NOGAPS heat fluxes

SST: 1/8° MODAS SST analyses

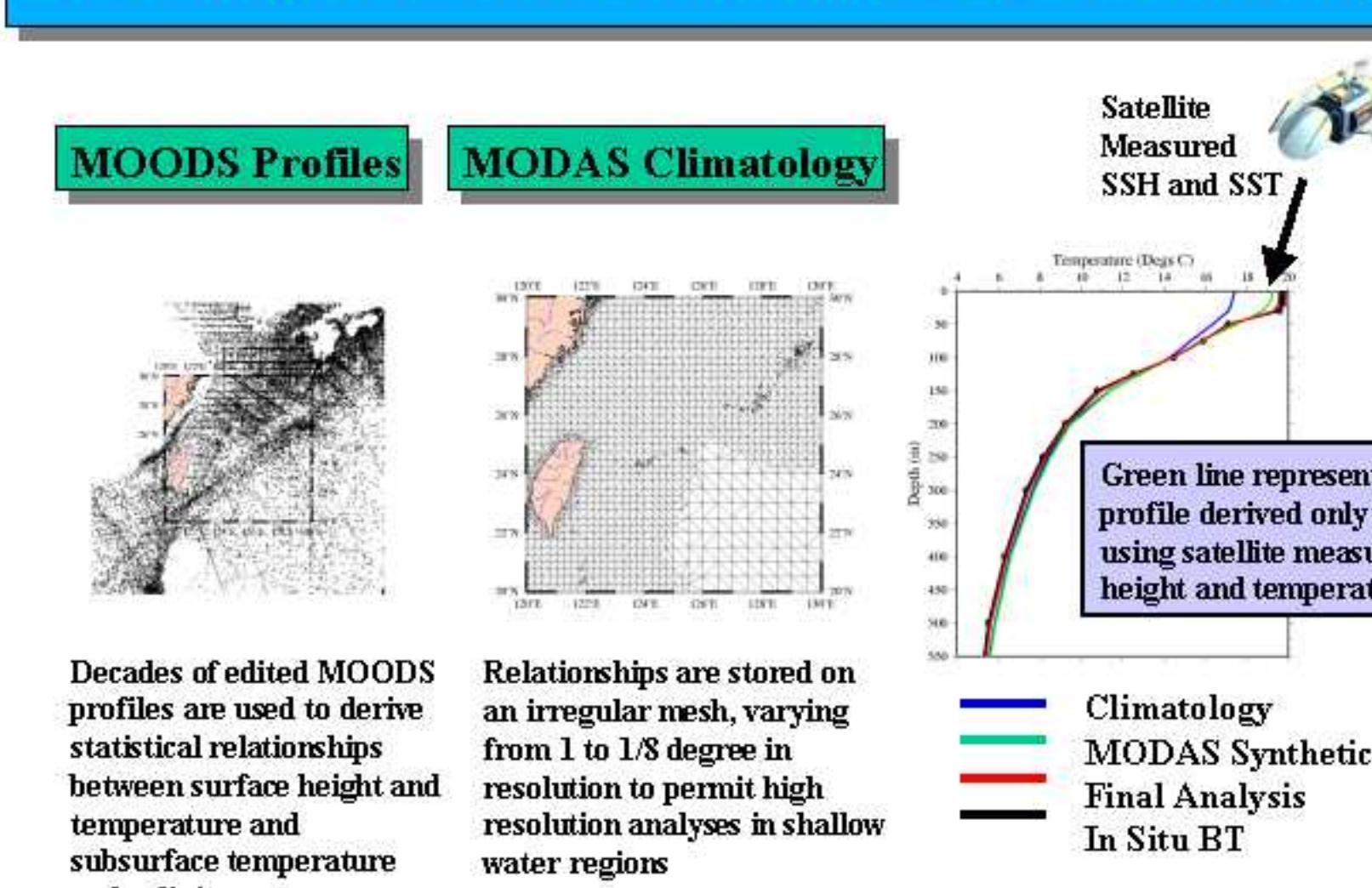
In order to utilize the most accurate altimeter data, the system starts three days back in time and uses analysis wind and thermal forcing as it assimilates altimeter and SST data up to the nowcast time

- NOGAPS forecast wind and thermal forcing are used to produce a 4-day forecast, except on Wednesdays when a 30-day forecast is made
- Climatological wind and thermal forcing are used to extend the forecasts beyond 4 days
- In forecast mode, no altimeter assimilation is performed, but SST is relaxed back to the nowcast SST with a climatological correction applied and an e-folding time scale of 1/4 the forecast length

Operational NLOM run cycle



MODULAR OCEAN DATA ASSIMILATION SYSTEM (MODAS)



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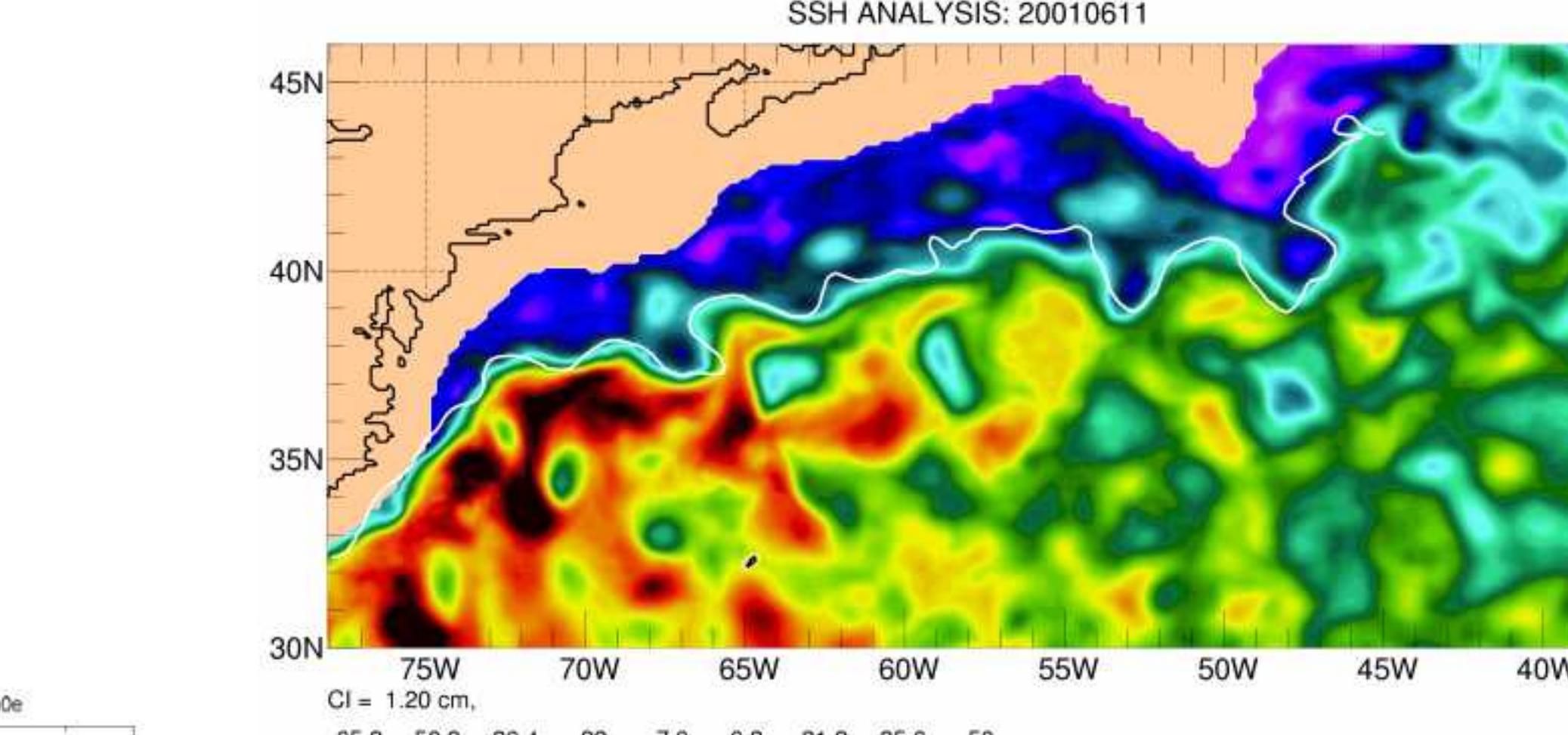
Naval Research Laboratory

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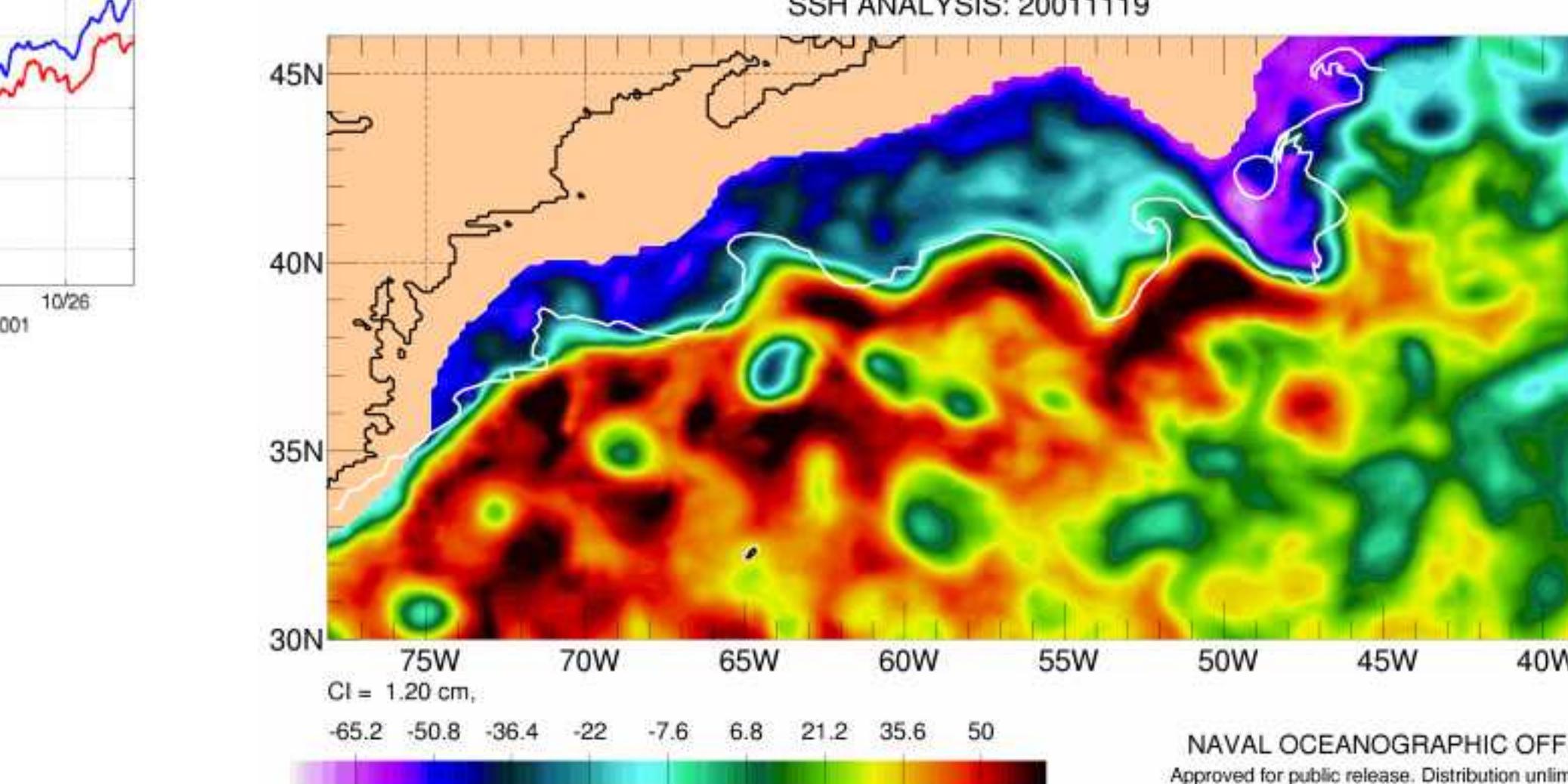
Sverdrup Technology

Gulf Stream IR North Wall vs SSH Pathway from NLOM

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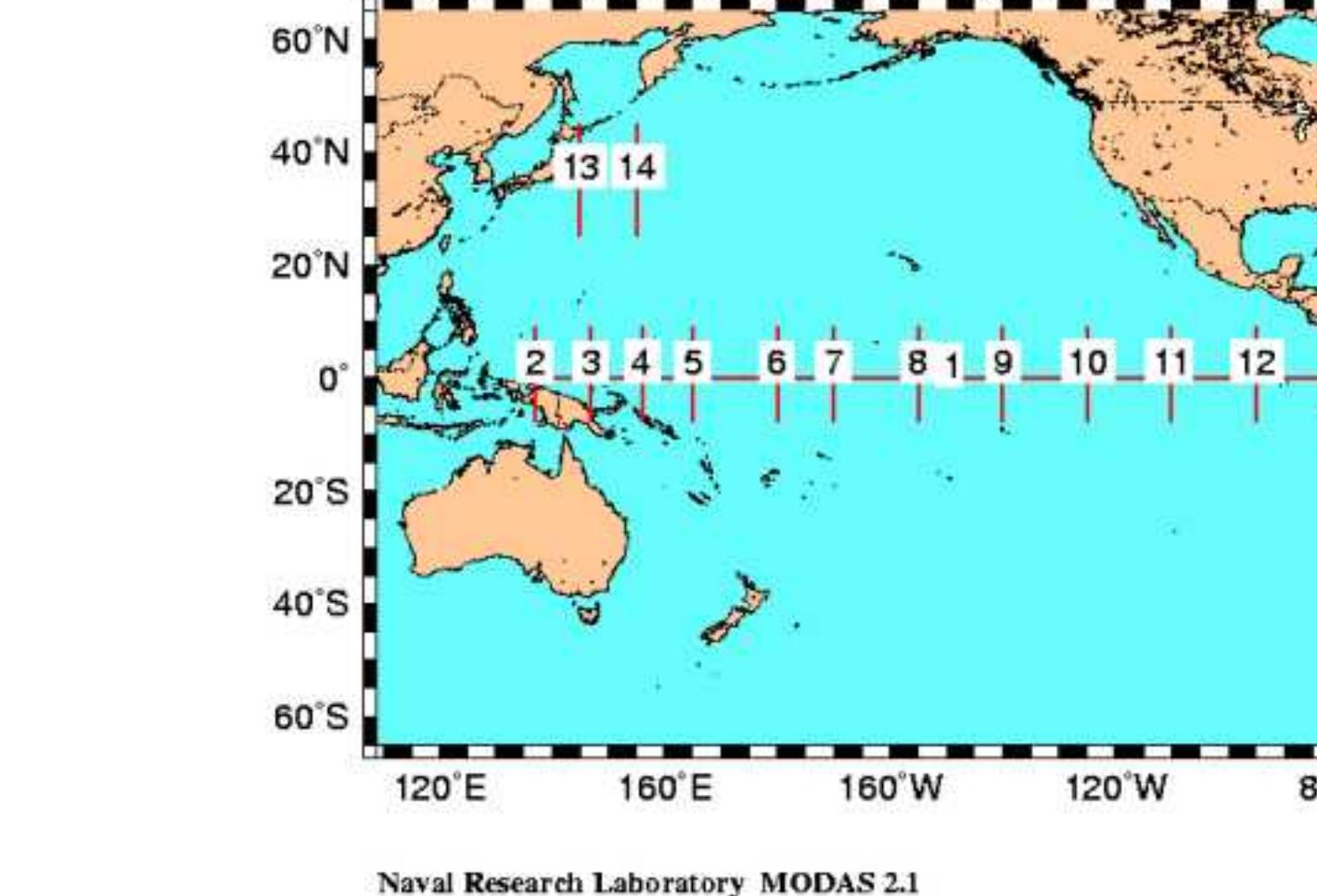


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Temperature and salinity profiles

Position of Vertical Sections



1/16° NLOM synthesis: Temperature (°C) Section 13 Pacific 11-29-2001 (145.0, 25.0) to (145.0, 45.0)

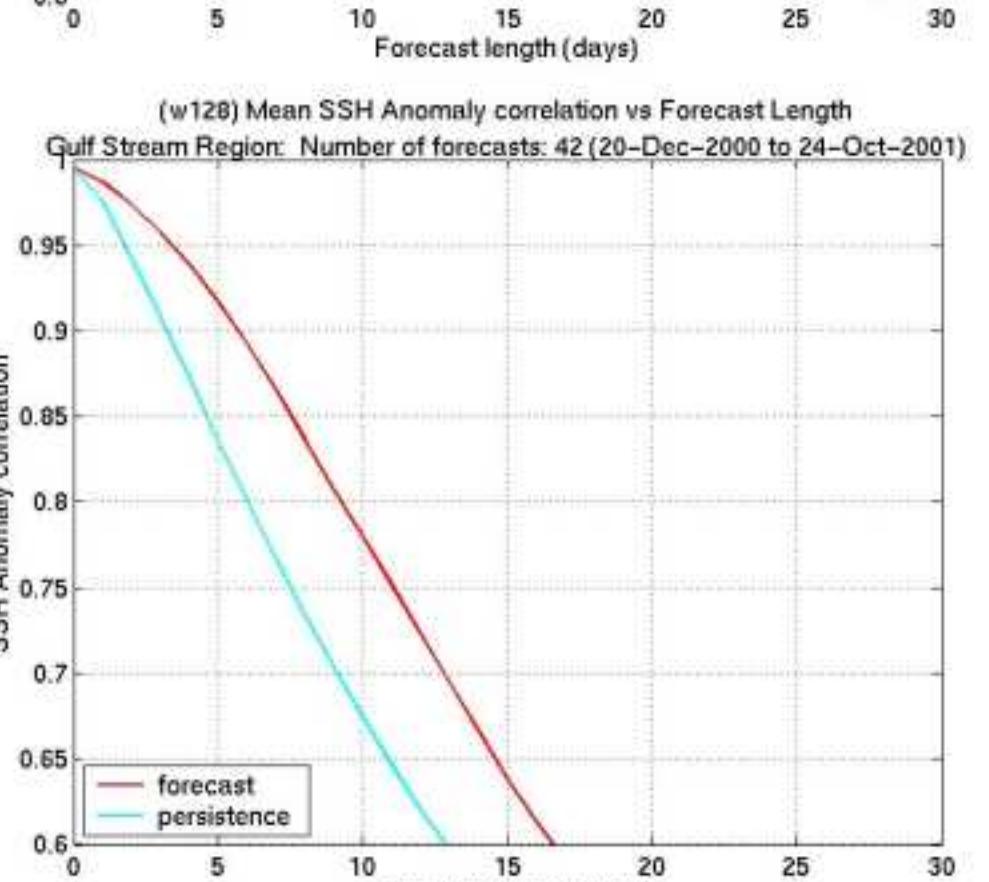
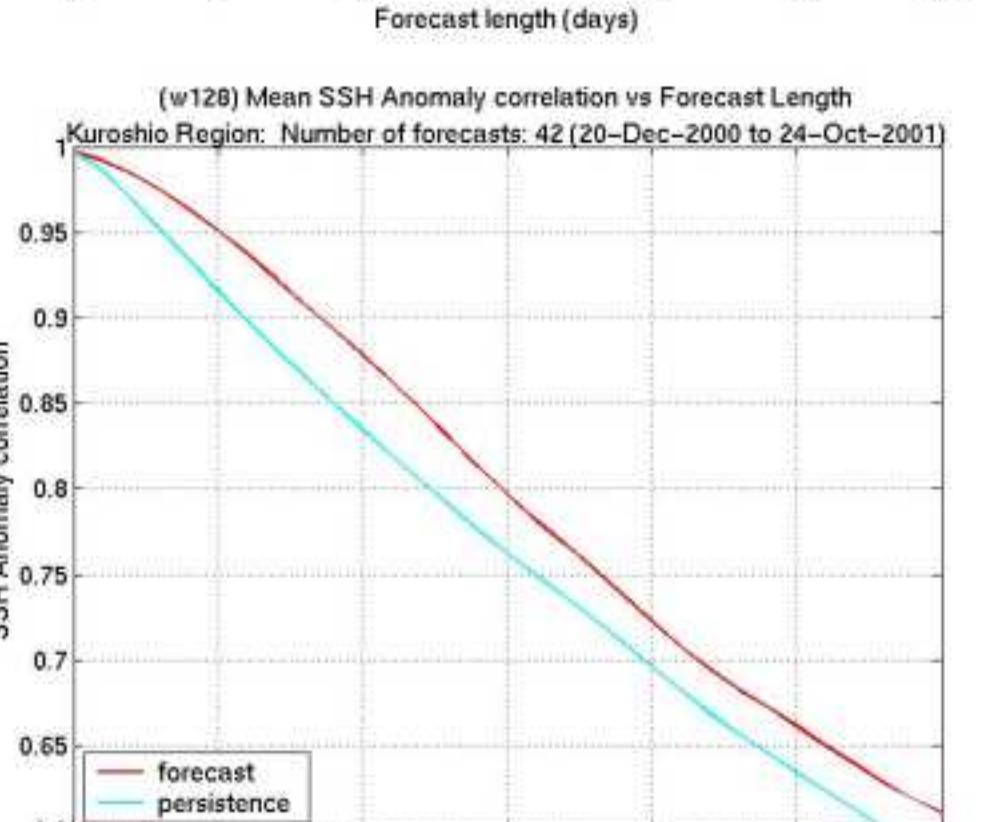
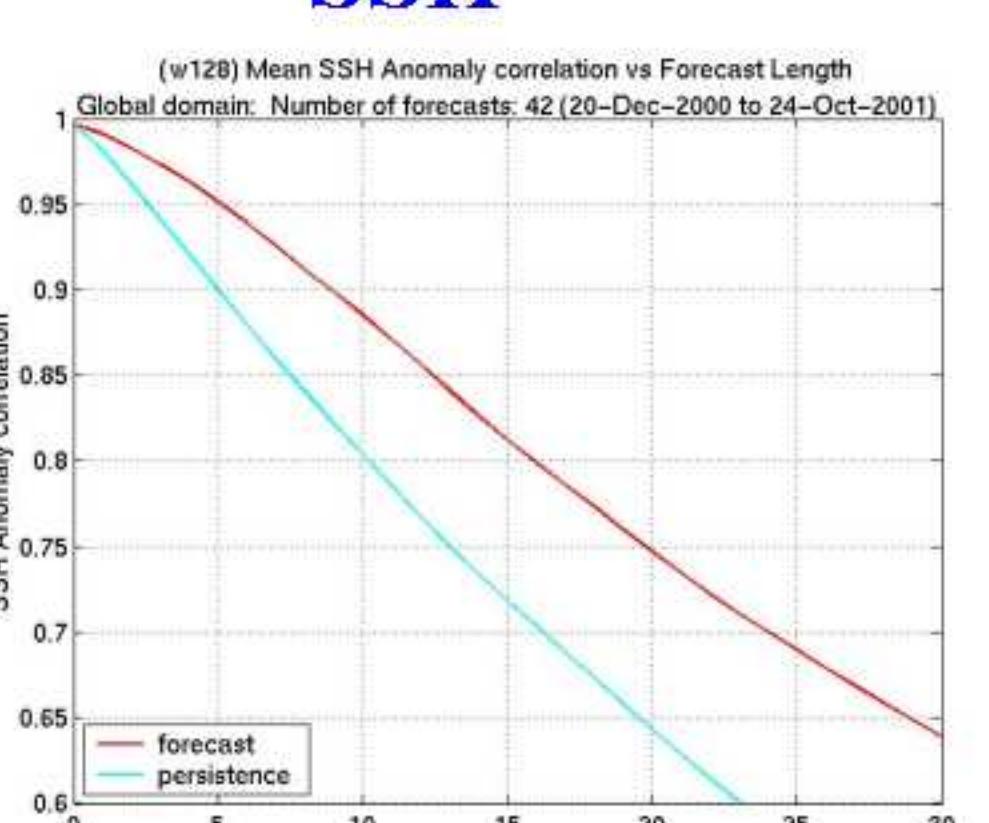
1/16° NLOM synthesis: Salinity Section 13 Pacific 11-29-2001 (145.0, 25.0) to (145.0, 45.0)

1/16° NLOM synthesis: Temperature (°C) Section 13 Pacific Forecast initialized: 11-28-2001 Valid: 12-12-2001 (145.0, 25.0) to (145.0, 45.0)

1/16° NLOM synthesis: Salinity Section 13 Pacific Forecast initialized: 11-28-2001 Valid: 12-12-2001 (145.0, 25.0) to (145.0, 45.0)

Forecast statistics

SSH



SST

